

Upsurge in meningitis cases in Jirapa district, 2017, Upper West - Ghana

Oteng Gideon¹, Akyereko Ernest¹, Broni Francis¹, Ojo John¹, Tamal Christopher Sunkwa¹, Mensah Marlon George¹, Delia Akosua Bandoh¹, Ameme Donne¹, Kenu Ernest^{1, &}

¹Ghana Field Epidemiology and Laboratory Training Program School of Public Health-University of Ghana, Accra, Ghana

KEYWORDS: Jirapa, Upper West, Meningitis, Upsurge

ABSTRACT

Introduction: Meningitis is the inflammation of the meninges. In the first eight (8) epidemiological weeks of 2017, Jirapa District, Upper West Region, Ghana recorded 41 suspected cases with six deaths and this had exceeded the alert threshold of 5 suspected cases per 100,000 population per week. We therefore conducted an epidemiological investigation, assessed surveillance and epidemic response and helped implement control measures. **Methods:** We conducted a descriptive study in Jirapa District 21st to 25th March, 2017. We reviewed patient records from January to March with clinicians, response and surveillance assessment and searched for cases. The case definition was any person living in Jirapa District and reporting with or without fever of acute onset with neck stiffness, poor sucking (in infants), bulging fontanelles (in infants), altered consciousness, other signs of meningeal irritation/inflammation from 1st January to 25th March, 2017. Descriptive analysis was performed and expressed as frequencies and proportions with Microsoft Excel, 2016. **Results:** Sixty-one cases were recorded, of which 10 were confirmed with seven deaths (CFR=70%). Most were female 32 (53.33%) and majority, 21 (34.4%) below age 10 years. *Streptococcus pneumoniae* was the causative organism in all the 10 samples. Although the number of reported meningitis cases and the CFR were high, the epidemic threshold of 10 suspected cases per 100,000 population per week was not crossed. There was an active surveillance and effective rapid response team in the district conducted health education and contact tracing when the number of cases were increasing. **Conclusion:** Jirapa District saw an increase in the number of reported meningitis cases in 2017. An active surveillance system and effective rapid response team in the district prevented a potential outbreak. Communities were educated on risk factors, preventive measures to reduce spread and the need for early reporting.

*CORRESPONDING AUTHOR

Ernest Kenu, Ghana Field Epidemiology and Laboratory Training Program School of Public Health-University of Ghana, Accra, Ghana. ernest_kenu@yahoo.com

RECEIVED

24/05/2020

ACCEPTED

16/05/2022

PUBLISHED

29/06/2022

LINK

<https://www.afenet-journal.net/content/article/5/14/full/>

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CITATION

Oteng Gideon et al. Upsurge in meningitis cases in Jirapa district, 2017, Upper West - Ghana. Journal of Interventional Epidemiology and Public Health. 2022 June;5(2):14.

DOI: <https://doi.org/10.37432/jieph.2022.5.2.62>

Introduction

Meningitis is mainly caused by viruses and bacteria, with bacterial meningitis being more severe due to rapid onset and significant risk of death [1]. Bacterial meningitis is a severe acute infection treatable with antibiotics, 10-15% of patients die and survivors often have permanent damage such as hearing loss, brain damage, or paralysis of the arms or legs [2-4]. The most common bacterial meningitis etiologic agents are *Neisseria meningitides*, *Streptococcus pneumonia* and *Haemophilus influenza*. *Streptococcus pneumonia* is responsible for two-thirds of cases in Europe and the United States [5] and mostly affects infants, the elderly and immunocompromised patients [6].

The incidence of meningitis due to *Neisseria meningitides* worldwide is highest in the “African Meningitis Belt”, which is a strip of land extending from Senegal in the west to Ethiopia in the east (26 countries), where recurring epidemics results in incidence rates of greater than 1,000 cases per 100,000 population [7]. Pneumococci were not usually thought to cause meningitis outbreaks with occasional outbreaks occurring from time to time among prisoners and military camps involving few cases [8]. However, major outbreaks have been reported in countries in the African meningitis belt between 1998 and 2004 that have many of the epidemiological features of classical meningococcal epidemics [9,10]. The epidemics mostly occur during the dry season between November and May, when high temperature, low humidity, dust winds, cold nights and upper respiratory tract infections combine to damage the nasopharyngeal mucosa and the immune defense, which favour the occurrence of disease [8,11,12].

The Northern, Upper East and Upper West Regions of Ghana lies completely in the meningitis belt and along with parts of the Brong Ahafo Region, and experience outbreaks of meningitis [13,14]. Jirapa District recently recorded a mixed pneumococcal and meningococcal outbreak in 2016 with 233 cases and a case fatality rate of 12.4% [15].

To determine if an outbreak has occurred require a standard (threshold) to which the number of cases occurring can be compared to. For populations above 30,000, the threshold for meningitis is at 10 suspected cases per 100,000 population per week [16]. In the first eight (8) epidemiological weeks of

2017, Jirapa district recorded 41 cases with six (6) deaths and this had exceeded the alert threshold of five suspected cases per 100,000 population per week. Public health officials of the Ghana Field Epidemiology and Laboratory Training Program (GFELTP) were notified of the situation and a team was dispatched to conduct an epidemiological investigation, assess surveillance and epidemic response and help implement control measures.

Methods

Setting

The investigation was conducted in Jirapa District, one of 13 administrative districts in the Upper West region of Ghana. The Upper West Region is located in northwest Ghana and falls within the African meningitis belt. The district was created from the former Lawra District Council in 1988 and has a population of 101,899, which forms about 13.1% of the regional population. The District, like the rest of the region, experiences a short raining season from June to October, followed by a long hot dry season from November to May, with temperatures going up to as high as 40oC. The district shares boundaries with Lawra, Lambusie-Karni, Nadowli- Kaleo, Sisala East and the Dafiama-Busie- Issah Districts.

Study Design

We conducted a descriptive epidemiological study in Jirapa District between 21st and 25th March, 2017 to investigate the upsurge in meningitis cases. Patient health records were reviewed to construct a case definition. The case definition was then used to conduct active case search for patients that might have not reported or might have been missed. We also conducted interviews with health staff and patients and assessed surveillance and epidemic response.

Data collection methods

We interviewed health staff and patients with structured questionnaires and reviewed patient records. Health records at the St. Joseph’s Hospital in Jirapa and Jirapa District Health Directorate were reviewed to identify all reported cases of meningitis in the district between the first and the eleventh weeks of 2017. The information on the signs and symptoms such as fever, neck stiffness, poor sucking

and bulging fontanelles in infants, altered consciousness, seizures and other meningeal signs were abstracted from patient folders and used to construct a working case definition.

Case definition

Based on records reviewed and the standard case definition for meningitis, we defined cases as:

Suspected case: Any person living in Jirapa District and reporting with or without fever of acute onset with one or more of the following meningeal signs: neck stiffness, poor sucking (in infants), bulging fontanelles (in infants), altered consciousness, irritability, seizures, other signs of meningeal irritation/inflammation from 1st January to 25th March, 2017.

Confirmed case: A suspected case confirmed by isolation of *N. meningitides* or *Streptococcus pneumoniae*, *H. Influenza* or any other agent of meningitis. All cases who met the case definition were line listed. The list contained variables including patient age, sex, date of onset of illness, date of reporting, residence, laboratory results, signs and symptoms, and outcome.

Laboratory Analysis

Cerebrospinal fluid (CSF) samples were collected at Jirapa Hospital into sterile cryo tubes and tested by Gram's staining, culture, and latex agglutination. Results are usually ready within four days.

Response and preparedness

We assessed Jirapa District preparedness to meningitis by assessing availability of case definition, laboratory capacity, reporting to next level, data collection and analysis procedures and also their epidemic response readiness using a structured questionnaire.

Investigation response

Health education was done on radio as well as by a team that moved through the various communities. It was mainly focused on keeping good personal hygiene to help prevent the spread of disease like washing hands often with soap and water; eating a well-balanced diet, rich in vegetables and fruits;

getting enough sleep, exercising regularly and avoiding cigarettes, drugs and alcohol. It also touched on the signs and symptoms of the disease and the need for early reporting. All this was done in addition to contact tracing of cases.

Data management

We used a threshold of 10 suspected cases per 100,000 population per week. Data was entered into Microsoft Excel 2016. Data on patient's date of onset of illness were used to construct an epidemic curve. We categorized age into age groups and generated frequencies and cumulative frequencies. Data was analyzed descriptively and presented as charts and graphs with Microsoft Excel.

Ethical Considerations

The Disease Surveillance Department of the Ghana Health Service which is the highest authority for implementing surveillance activities in Ghana gave approval for investigating the upsurge of meningitis cases. Permission was obtained from the Ghana Health Service regional, district health directorates and the district hospital. Consent was sought from health staff and patients before interviews were conducted with them. Personal identifiers were not used in analysis and data was kept confidential.

Results

Descriptive epidemiology

A total of 61 case had been recorded of which 10 (16.4%) were laboratory confirmed with 7 deaths (70% case fatality rate). The median age of the cases was 16.5 years (IQR 1-86 years). The cases involved people from over 42 of the 137 communities in Jirapa District, with Jirapa Sub District having the highest percentage of cases (67.2%) and about 13% reporting from outside Jirapa District [Table 1](#). Most of the case were female 33 (54.1%). Majority of the cases (34.4%) were below age 10 and children of school going age (below 20 years) made up about 25 (41%) of the cases [Table 1](#).

The overall attack rate was 60/100,000 population but the highest was in Jirapa Urban sub-district with 118/100,000 population [Table 2](#).

The epicurve [Figure 1](#) suggest a propagated spread with cases steadily rising from the first epidemiological week and peaking in the third week with nine (9) cases. There were decreases and increases in the number of cases as the weeks progressed with the lowest case (1) being recorded in the ninth week while the highest cases after the peak were recorded in the seventh and eleventh weeks with eight each.

Although the number of reported meningitis cases were highest in the third week (9), the epidemic threshold of 10 suspected cases per 100,000 population per week was not crossed [Figure 1](#).

Preventive and control measures; mainly health education was performed by the district in week 4 and again with the help of the investigation team in week 12 [Figure 1](#). Health education given created awareness of meningitis and made the various communities more eager to help prevent the spread and report signs and symptoms early.

Laboratory Findings

Fifty-eight 58 (96.67%) lumbar punctures were done and the laboratory tested all 58 (100%) case samples. Upon Gram staining, 10 (17.24%) of the samples showed Gram Positive Diplococci (GPD) and were also positive for *Streptococcus pneumonia* when latex agglutination was used.

Streptococcus pneumonia was also isolated from these 10 samples using culture without antibiotic susceptibility testing.

Surveillance and Epidemic Response assessment finding

The District had case definitions that were being used by health staff at the various facilities. Using this case definition, suspected cases were referred from the sub district levels to the St. Joseph's hospital, which had enhanced laboratory capability for confirmation of cases and up-to-date treatment protocols on meningitis with enough case base forms for reporting to the next level. Case based forms were then forwarded to the Disease Control Officer who created a line list that was updated at the end of each day and forwarded to Jirapa District Health Directorate twice every week. The District Disease Control Officer performed routine data analysis on

reported cases and a spot map was drawn to show distribution of cases. There was an active epidemic response team in the District made up of people from both the District Health Directorate and the St. Joseph's Hospital. That team with the help of community volunteers were doing contact identification and tracing, follow up of cases, as well as public education in response to the situation. There was evidence of meningitis training for health staff at the various health facilities which was done at least once every year.

Clinical management

Clinical management was done in the St. Joseph Hospital which is the main referral center for the district. Some of the common sign and symptoms presented were fever (57; 93.4%), neck stiffness (40; 65.6%), headache (60; 98.4%) and altered consciousness (30; 49.2%), but four out of the 10 confirm cases did not present with fever at the time of reporting.

Treatment initiated promptly using intravenous (IV) Ceftriaxone which is a broad-spectrum antibiotic for 5-7 days as the antibiotic of choice. Adjunctive dexamethasone (a steroid) was given concomitantly with the antibiotic dose.

Discussion

We set out to investigate and characterize a suspected meningitis upsurge, help implement control measures and assess Jirapa District meningitis surveillance and epidemic response system in place. Our investigation showed that although the Jirapa District experienced high case fatality rates of pneumococcal meningitis, the epidemic threshold of 10 suspected cases per 100,000 population per week had not been crossed due to an active surveillance system and the District Epidemic Response Team's prompt response to the situation. This active surveillance system and the prompt action of the District Epidemic Response Team may be attributed to the District being in the African meningitis belt and so have experienced outbreaks over the years. Health staff are therefore trained each year on meningitis to enhance their knowledge and expertise [15] in addition to their experiences gained in handling previous outbreaks.

Streptococcus pneumoniae was the causative organism isolated. Although meningococcal meningitis are mostly responsible for outbreaks in the meningitis belt and also in the country, the recent upsurge of pneumococcal meningitis outbreaks that mimic most of the epidemiological features of classical meningococcal epidemics [8-10] are becoming more common [14,15]. A similar outbreak caused by Pneumococcal and Meningococcal meningitis was reported in the Jirapa District in 2016 which led to a mass vaccination. However due to the different serotypes of *Strep. Pneumonia* isolated, meningococcal conjugate vaccine (MenAfriVac®) alone was used [17]. This therefore highlights the need for enhanced focus and monitoring of pneumococcal diseases in Ghana.

People of all ages were affected, but most of the cases were children under 10 years which is typical with pneumococcal meningitis which affects all ages but with children being more at risk [18]. The proportion of children of school going age being affected suggests that schools could be a potential source of infection transmission that should be targeted for educational campaigns and other preventive interventions.

Jirapa Urban sub-district is the district capital and therefore the central hub of the District with populations exceeding the other sub-districts by more than twice. This high population in relation to the other sub-districts might have contributed to the high attack rate. We educated the community members on the detection of early signs of meningitis and preventive measures to reduce spread as we realized that public education to encourage easy identification and early reporting to health facilities was best option for bringing down the number of cases.

The detection and clinical management of cases by the referral hospital in the district met the minimum standards required but although the laboratory was able to perform culture on all samples, no antibiotic susceptibility testing was done and this was due to logistical constraints in purchasing the reagents needed to perform that test. This non-performance of antibiotic susceptibility testing was worrying as resistance to antibiotics would not be noticed and could lead to treatment failure and hence increase in case fatality in subsequent cases in the near future.

Conclusion

The Jirapa District of the Upper West Region saw an increase in the number of reported meningitis cases in 2017, caused by *Streptococcus pneumoniae* and affected mostly children under the age of 10 years. Due to an active surveillance system and an effective rapid response team in the district it was noticed early so that preventive and control measures could be instituted. The laboratory however was not able to perform antibiotic susceptibility testing on samples.

We recommend that the St. Joseph's Hospital laboratory perform antibiotic sensitivity testing, the DHMT intensify surveillance in the district, while continuing with health education on meningitis, as well as the Regional Health Directorate to serotype *Streptococcus pneumoniae* to determine strain and vaccination requirements, while providing logistical support to the district in terms of laboratory reagents etc.

What is known about this topic

- Bacterial meningitis is a severe acute infection treatable with antibiotics;
- The Jirapa District of the Upper West Region falls in the meningitis belt of Africa;
- Epidemic bacterial meningitis occurs across the meningitis belt in Africa.

What this study adds

- An active surveillance system and an effective rapid response team can lead to the prevention of an outbreak;
- Aside meningococcal meningitis mostly responsible for outbreaks in the meningitis belt and in the country, *Streptococcus pneumoniae* can also cause outbreaks in Ghana;
- *Streptococcus pneumoniae* affected mostly children under the age of 10 years.

Competing interests

The authors declare no competing interests.

Authors' contributions

GO, EA, FB, JO, CST, GMM, DKA, DABB, EK — conceptualized the plan of the investigation. GO, EA, FB, JO, CST, GMM investigated the upsurge. GO, EA, FB, JO, CST, GMM wrote the report. GO, DKA, DABB, EK drafted the manuscript. All authors read and approved of the final version of the manuscript.

Acknowledgments

We gratefully acknowledge the efforts of the Ghana Field Epidemiology and Laboratory Training Program for their immense effort and contribution in facilitating this investigation and availing residents the opportunity to participate in the exercise. We also acknowledge the help and contribution of the Upper West Regional and Jirapa District health directorates and management teams for making this investigative exercise easier for residents in terms of accommodation and other logistics.

Tables and figures

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Table 2: Attack rates by gender, age and sub-district of residence

Figure 1: Epi curve of meningitis cases with epidemic threshold in Jirapa District, Upper West Region, Ghana, 1st January, 2017 to 25th March, 2017

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| Table 1: Descriptive characteristics of study participants | | | | |
|---|-------------------|------------------------|---------------|------------|
| Characteristic | Number (%) | Confirmed cases | Deaths | CFR |
| Gender | | | | |
| Male | 28 (45.9) | 4 | 3 | 75 |
| Female | 33 (54.1) | 6 | 4 | 66.7 |
| Ages (Years) | | | | |
| <10 | 21 (34.4) | 2 | 1 | 50 |
| 10-19 | 4 (6.6) | 1 | 1 | 100 |
| 20-29 | 14 (22.9) | 2 | 1 | 50 |
| 30-39 | 4 (6.6) | | | |
| 40-49 | 3 (4.9) | 2 | 1 | 50 |
| 50-59 | 8 (13.1) | 1 | 1 | 100 |
| 60-69 | 3 (4.9) | | | |
| >69 | 4 (6.6) | 2 | 2 | 100 |
| Sub Districts | | | | |
| Duori | 1 (1.6) | | | |
| Hain | 1 (1.6) | | | |
| Jirapa Urban | 41 (67.2) | 8 | 5 | 62.5 |
| Sabuli | 2 (3.3) | | | |
| Tizza | 2 (3.3) | 1 | 1 | 100 |
| Tuggo | 2 (3.3) | | | |
| Ullo | 3 (4.9) | | | |
| Yagha | 1 (1.6) | | | |
| Resident Outside Jirapa District | | | | |
| Lawra | 6 (9.8) | 1 | 1 | 100 |
| Lambussie | 1 (1.6) | | | |
| Nadowli | 1 (1.6) | | | |

| Table 2: Attack rates by gender and sub-district of residence | | | |
|--|----------------------------------|-------------------|-------------------------------|
| Characteristic | Number of suspected cases | Population | Attack rate/population |
| Gender | | | |
| Male | 28 | 47893 | 58/100000 |
| Female | 33 | 54006 | 61/100000 |
| Sub Districts | | | |
| Duori | 1 | 8131 | 12/100000 |
| Hain | 1 | 12420 | 8/100000 |
| Jirapa Urban | 41 | 34676 | 118/100000 |
| Sabuli | 2 | 7887 | 25/100000 |
| Tizza | 2 | 8189 | 24/100000 |
| Tuggo | 2 | 9661 | 21/100000 |
| Ullo | 3 | 10815 | 28/100000 |
| Yagha | 1 | 10120 | 10/100000 |
| Resident Outside Jirapa District | | | |
| Lawra | 6 | 54889 | 11/100000 |
| Lambussie | 1 | 51654 | 2/100000 |
| Nadowli | 1 | 61561 | 2/100000 |
| Overall | 61 | 101899 | 60/100000 |

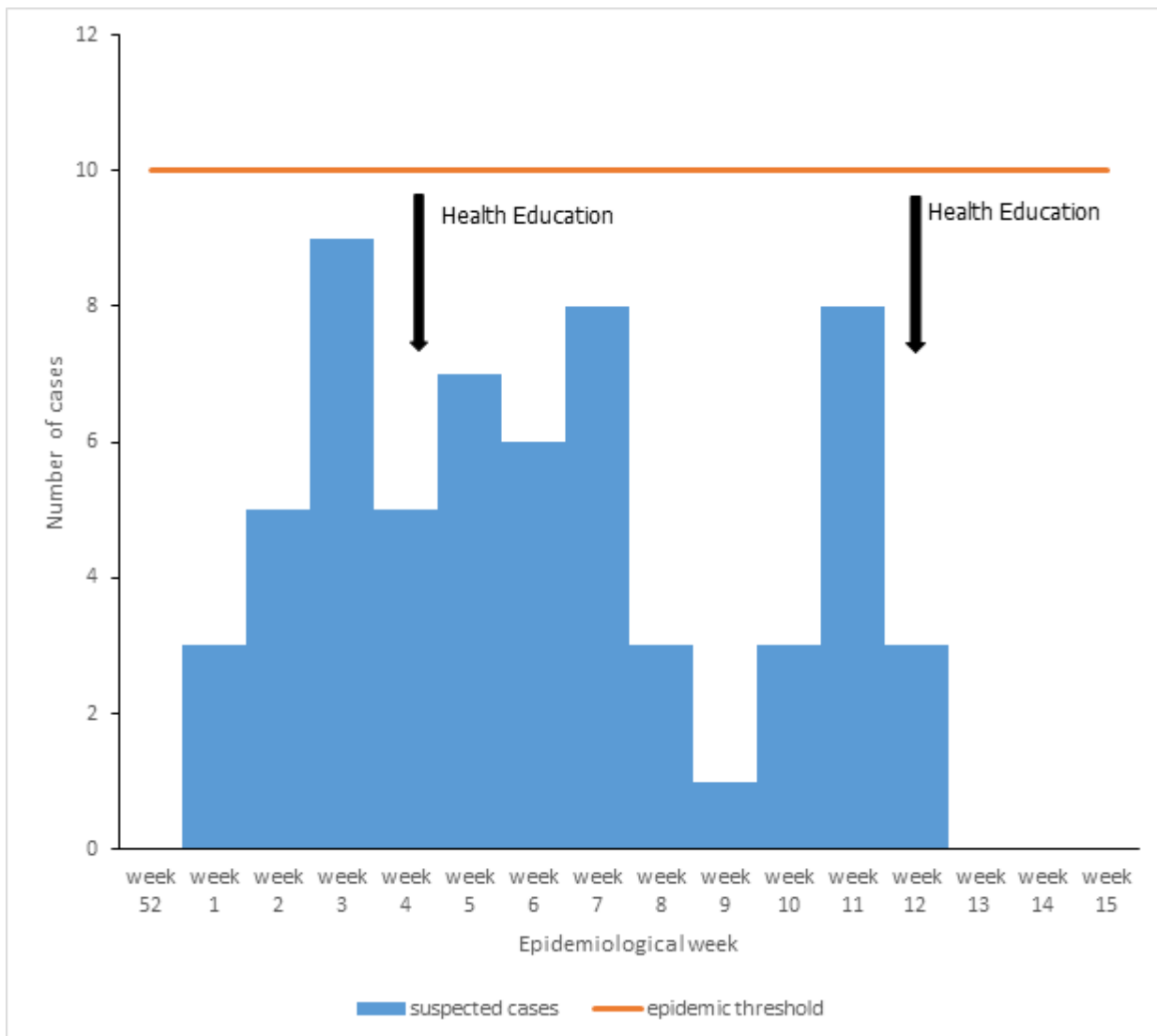


Figure 1: Epi curve of meningitis cases with epidemic threshold in Jirapa District, Upper West Region, Ghana, 1st January, 2017 to 25th March, 2017